

CLAIMS:

1. A method for segmenting a heart rate signal to identify heart rate feature events, said method comprising:
 - 5 a) receiving a heart rate signal including a sequence of sample points;
 - b) processing the heart rate signal to generate a set of segments, each segment being formed by enclosing a portion of said heart rate signal in a respective bounded area, the bounded area commencing at a start sample point of said heart rate signal and terminating at an end sample point of said heart rate
10 signal, wherein the sample points between said start sample point and end sample point lie within said bounded area;
 - c) processing the set of segments to generate a plurality of sections, each section being indicative of a heart rate feature;
 - d) releasing a signal indicative of said plurality of sections.
- 15 2. A method as defined in claim 1, wherein the heart rate feature is selected from the set consisting of an acceleration event, a deceleration event and a baseline event.
3. A method as defined in claim 1, wherein said bounded area is a trapezoid.
- 20 4. A method as defined in claim 3, wherein said trapezoid is a parallelogram.
5. A method as defined in claim 4, wherein for each segment, a polynomial approximation of the sample points between said start sample point and end
25 sample point lies within the corresponding bounded area.
6. A method as defined in claim 5, wherein said polynomial approximation of the sample points between said start sample point and end sample point is a line of best fit.
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7. A method as defined in claim 3, wherein a trapezoid associated with a given segment of said heart rate signal has a height conditioned at least in part on the basis of the variability of at least part of said heart rate signal.
- 5 8. A method as defined in claim 7, wherein the least part of said heart rate signal is the portion of the heart rate signal enclosed within said trapezoid.
9. A method as defined in claim 1, wherein said the bounded area is characterized by a certain drift and a certain excursion.
- 10 10. A method as defined in claim 9, wherein the certain excursion is conditioned at least on part on the basis of the heart rate signal.
11. A method as defined in claim 10, wherein the certain excursion is conditioned at
15 least on part on the basis of a variability associated with the heart rate signal.
12. A method as defined in claim 3, wherein said signal indicative of said plurality of sections includes a list of labeled sections including a plurality of data elements, each data element being associated with a respective section and including a label
20 component, the label component being indicative of either one of an acceleration event, deceleration event and baseline event.
13. A method as defined in claim 3, wherein said set of segments is generated using a recursive process.
- 25 14. A method as defined in claim 13, wherein said recursive process includes:
 - a) forming a segment of said set of segment by enclosing a portion of said heart rate signal in a bounded area, thereby leaving at least one remaining portion of the heart rate signal, the at least one remaining portion including sample points
30 of the heart rate signal excluded from the enclosed portion;
 - b) repeating a) recursively for said at least one remaining portion of said heart rate signal until a certain condition is met.

15. A method as defined in 14, wherein the certain condition is met when the at least one remaining portion has a number of sample points below a pre-determined threshold number of sample points.
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16. A method as defined in claim 1, where said heart rate signal is indicative of a fetal heart rate signal.
17. An apparatus for segmenting a heart rate signal to identify heart rate feature events, said apparatus comprising:
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- a) an input for receiving a heart rate signal including a sequence of sample points;
 - b) a first processing unit coupled to said input, said first processing unit being adapted for processing the heart rate signal to generate a set of segments, each segment being formed by enclosing a portion of said heart rate signal in a respective bounded area, the bounded area commencing at a start sample point of said heart rate signal and terminating at an end sample point of said heart rate signal, wherein the sample points between said start sample point and end sample point lie within said bounded area;
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 - c) a second processing unit coupled to said first processing unit, said second processing unit being adapted for processing the set of segments to generate a plurality of sections, each section being indicative of a heart rate feature ;
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 - d) an output for releasing a signal indicative of said plurality of sections.
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18. An apparatus as defined in claim 17, wherein the heart rate feature is selected from the set consisting of an acceleration event, a deceleration event and a baseline event.
19. An apparatus as defined in claim 17, wherein said bounded area is a trapezoid.
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20. An apparatus as defined in claim 19, wherein said trapezoid is a parallelogram.

21. An apparatus as defined in claim 20, wherein for each segment, a polynomial approximation of the sample points between said start sample point and end sample point lies within the corresponding bounded area.
- 5 22. An apparatus as defined in claim 21, wherein said polynomial approximation of the sample points between said start sample point and end sample point is a line of best fit.
- 10 23. An apparatus as defined in claim 19, wherein a trapezoid associated with a given segment of said heart rate signal has a height conditioned at least in part on the basis of the variability of at least part of said heart rate signal.
- 15 24. An apparatus as defined in claim 23, wherein the least part of said heart rate signal is the portion of the heart rate signal enclosed within said trapezoid.
- 20 25. An apparatus as defined in claim 17, wherein said the bounded area is characterized by a certain drift and a certain excursion.
26. An apparatus as defined in claim 25, wherein the certain excursion is conditioned at least on part on the basis of the heart rate signal.
27. An apparatus as defined in claim 26, wherein the certain excursion is conditioned at least on part on the basis of a variability associated with the heart rate signal.
- 25 28. An apparatus as defined in claim 19, wherein said signal indicative of said plurality of sections includes a plurality of data elements, each data element being associated with a respective section and including a label component, the label component being indicative of either one of an acceleration event, deceleration event and baseline event.
- 30 29. An apparatus as defined in claim 19, wherein said first processing unit implements a recursive process for generating said set of segments.

30. An apparatus as defined in claim 29, wherein said recursive process includes:
- a) forming a segment of said set of segment by enclosing a portion of said heart rate signal in a bounded area, thereby leaving at least one remaining portion of the heart rate signal, the at least one remaining portion including sample points of the heart rate signal excluded from the enclosed portion;
 - b) repeating a) recursively for said at least one remaining portion of said heart rate signal until a certain condition is met.
31. An apparatus as defined in claim 30, wherein the certain condition is met when the at least one remaining portion has a number of sample points below a pre-determined threshold number of sample points.
32. An apparatus as defined in claim 18, where said heart rate signal is indicative of a fetal heart rate signal.
33. A computer readable storage medium including a program element suitable for execution by a computing apparatus for segmenting a heart rate signal to identify heart rate feature events, said computing apparatus comprising:
- a) a memory unit;
 - b) a processor operatively connected to said memory unit, said program element when executing on said processor being operative for:
 - i. receiving a heart rate signal including a sequence of sample points;
 - ii. processing the heart rate signal to generate a set of segments, each segment being generated by enclosing a portion of said heart rate signal in a respective bounded area, the bounded area commencing at a start sample point of said heart rate signal and terminating at an end sample point of said heart rate signal, wherein the sample points between said start sample point and end sample point lie within said bounded area;
 - iii. processing the set of segments to generate a plurality of sections, each section being indicative of a heart rate feature;
 - iv. releasing a signal indicative of said plurality of sections.

34. A computer readable storage medium as defined in claim 33, wherein the heart rate feature is selected from the set consisting of an acceleration event, a deceleration event and a baseline event
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35. A computer readable storage medium as defined in claim 33, wherein said bounded area is a trapezoid.
36. A computer readable storage medium as defined in claim 35, wherein said
- 10 trapezoid is a parallelogram.
37. A computer readable storage medium as defined in claim 36, wherein for each segment, a polynomial approximation of the sample points between said start sample point and end sample point lies within the corresponding bounded area.
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38. A computer readable storage medium as defined in claim 37, wherein said polynomial approximation of the sample points between said start sample point and end sample point is a line of best fit.
- 20 39. A computer readable storage medium as defined in claim 35, wherein a trapezoid associated with a given segment of said heart rate signal has a height conditioned at least in part on the basis of the variability of at least part of said heart rate signal.
- 25 40. A computer readable storage medium as defined in claim 39, wherein the least part of said heart rate signal is the portion of the heart rate signal enclosed within said trapezoid.
- 30 41. A computer readable storage medium as defined in claim 34, wherein the bounded area is characterized by a certain drift and a certain excursion.

42. A computer readable storage medium as defined in claim 41, wherein the certain excursion is conditioned at least on part on the basis of the heart rate signal.
43. A computer readable storage medium as defined in claim 42, wherein the certain
5 excursion is conditioned at least on part on the basis of a variability associated with the heart rate signal.
44. A computer readable storage medium as defined in claim 35, wherein said signal
10 indicative of said plurality of sections includes a plurality of data elements, each data element being associated with a respective section and including a label component, the label component being indicative of either one of an acceleration event, deceleration event and baseline event.
45. A computer readable storage medium as defined in claim 35, wherein said
15 program element implements a recursive process for generated the set of segments.
46. A computer readable storage medium as defined in claim 45, wherein said recursive process includes:
20 a) forming a segment of said set of segment by enclosing a portion of said heart rate signal in a bounded area, thereby leaving at least one remaining portion of the heart rate signal, the at least one remaining portion including sample points of the heart rate signal excluded from the enclosed portion;
b) repeating a) recursively for said at least one remaining portion of said heart
25 rate signal until a certain condition is met.
47. A computer readable storage medium as defined in 46, wherein the certain condition is met when the at least one remaining portion has a number of sample points below a pre-determined threshold number of sample points.
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48. A computer readable storage medium as defined in claim 34, where said heart rate signal is indicative of a fetal heart rate signal.

49. A fetal monitoring system comprising:
- a) a sensor for receiving a signal indicative of a fetal heart rate;
 - b) an apparatus suitable for monitoring the condition of a fetus, said apparatus comprising:
 - i. an input coupled to said sensor for receiving a signal indicative of a fetal heart rate;
 - ii. a feature detection module coupled to said input, said feature detection module implementing:
 - (a) a first processing unit adapted for processing the heart rate signal to generate a set of segments, each segment being generated by enclosing a portion of said heart rate signal in a respective bounded area, the bounded area commencing at a start sample point of said heart rate signal and terminating at an end sample point of said heart rate signal, wherein the sample points between said start sample point and end sample point lie within said bounded area;
 - (b) a second processing unit adapted for processing the set of segments to generate a plurality of sections, each section being indicative of a heart rate feature;
 - iii. a post processing module coupled to said a feature detection module, said post processing module being adapted for deriving information on the basis of the heart rate features associated with said set of segments;
 - iv. an output for releasing the information derived from the heart rate features associated set of segments;
 - c) an output unit coupled to the output for said apparatus, said output unit being suitable for displaying the information derived from the heart rate features associated with said set of segments.
50. An apparatus for segmenting a heart rate signal to identify heart rate feature events, said apparatus comprising:
- a) means for receiving a heart rate signal including a sequence of sample points;

- 5 b) means for processing the heart rate signal to generate a set of segments, each segment being formed by enclosing a portion of said heart rate signal in a respective bounded area, the bounded area commencing at a start sample point of said heart rate signal and terminating at an end sample point of said heart rate signal, wherein the sample points between said start sample point and end sample point lie within said bounded area;
- c) means for processing the set of segments to generate a plurality of sections, each section being indicative of a heart rate feature;
- 10 d) means for releasing a signal indicative of said plurality of sections.